

# The Prostaglandin-Prostacyclin-Nitric Oxide Connection

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Sidebar: Highly Cited Nitric Oxide Articles by Salvador Moncada

As part of my keynote address at the 10th International Conference on Prostaglandins and Related Compounds in Vienna on September 22, I reviewed my 1984 analysis of the 1982 Nobel Prize in physiology or medicine that honored the work of Sir John R. Vane, Sune K. Bergstrom, and Bengt I. Samuelsson in advancing prostaglandin research (E. Garfield, *Current Contents*, 12:3-12, March 19, 1984). This field has grown enormously since then. Between 1981 and 1995, about 3,000 papers per year were published that explicitly used the term "prostaglandins," or related terms such as "prostacyclins," "leukotrienes," and "thromboxanes," in their titles.

For the Vienna talk, we created a file of more than 40,000 papers published from 1981 through 1995 whose titles contained "prostaglandin" and other related key words. These were extracted from the Science Indicators Database of the Philadelphia-based Institute for Scientific Information. We then were able to identify the most-cited authors in this field. One outstanding author is Salvador Moncada, formerly of Wellcome Research Foundation, Beckenham, England, and now at the Cruciform Project for Strategic Medical Research, University College, London.

Moncada's remarkable research accomplishments include participating in the discoveries of inhibition of prostaglandin biosynthesis by aspirin-like drugs, thromboxane synthesis and

its inhibitors, and prostacyclin, a prostaglandin that is a metabolite of arachidonic acid. More recently, Moncada and his colleagues discovered the biological role of nitric oxide. In particular, they demonstrated that nitric oxide is released from vascular endothelial cells in quantities that can account for the biological actions of the endothelium-derived relaxing factor (EDRF), a substance known to regulate smooth muscle tone in blood vessels.

Indeed, Moncada's most-cited work is the 1987 *Nature* paper reporting this discovery (R.M.J. Palmer et al., "Nitric oxide release accounts for the biological activity of endothelium-derived relaxing factor," 327:524-6). It has been explicitly cited in more than 4,300 publications to date. It was followed by many other super-cited research and review papers (see table).

While I was in Vienna, the New York-based Albert and Mary Lasker Foundation announced its 1996 awards (K.Y. Kreeger, *The Scientist*, Oct. 28, 1996, page 3). Ferid Murad, former president and CEO of Molecular Geriatrics Corp. in Lake Bluff, Ill., and Robert Furchgott, Distinguished Professor, Emeritus, at the State University of New York Health Science Center, Brooklyn, were deservedly recognized for their pioneering work on nitric oxide by receiving the foundation's Albert Lasker Basic Medical Research Award.

Conspicuous by his absence in this honor, which is widely considered to be a Nobel predictor, was Moncada. Indeed, Joseph L. Goldstein, chairman of the Lasker jury and of the department of molecular genetics at the University of Texas Southwestern Medical Center, Dallas, himself stated in his introductory remarks at the October 4 ceremony, "[In 1987] Salvador Moncada and Lewis Ignarro . . . confirmed that EDRF and nitric oxide are one and the same, and this triggered an explosion of the nitric oxide field, opening floodgates of discovery."

It seems somewhat myopic not to have included Moncada in the Lasker award. In previous years, as many as five researchers have shared the Lasker honor. Why the Lasker jury chose not to find a seat at the table for Moncada in this instance is baffling.

Granted, the selection of award recipients by jury panels is typically a subjective process. But these decisions perhaps would be better informed by taking into account quantitative as well as qualitative data. For example, Moncada was on the list of the 1,000 most-cited authors of all time (E. Garfield, *Current Contents*, 41:5-14, Oct. 12, 1981). Furthermore, only about 25 scientists worldwide were cited in more than 25,000 publications from 1981 through 1994, and Moncada is one of them. And as I mentioned previously, many of his papers have been identified as super-cited classics in various studies too numerous to mention here. A list of his most-cited papers on nitric oxide appears on the following page.

Just last month, Moncada was given his due by the Worcester Foundation for Biomedical Research in Shrewsbury, Mass. He and Furchgott shared the 1996 Gregory Pincus Medal and Award for their discovery of nitric oxide. Furchgott said, "I'm particularly pleased that I won it with Dr. Moncada, who has done some of the really best work in the field." Regarding the Lasker award to himself and Murad, Furchgott commented, "[Moncada] certainly has done as much in developing the field as the two of us who received the award, or maybe more" (E. Thompson, *Worcester Telegram & Gazette*, Oct. 25, 1996, page B5).

Moncada's view on the Lasker award oversight is rather gracious. He stated, "I don't think scientists work for awards. If they come, one is greatly happy. If they don't, the satisfaction of doing the work is enough."

Recognition for scientific excellence comes in many forms. Among the most selective, limited, and subjective is the handful of prestigious prizes, such as the Nobel, Lasker, Pincus, and others. But perhaps among the most open, democratic, and objective is worldwide peer recognition through explicit citation, reflecting "intellectual debt" in the literature. The Scientist will continue to identify those high-impact researchers who deserve widespread recognition as indicated by their international colleagues' explicit citations in scientific publications. While we must always be aware that delayed recognition is not unusual in Nobel-class awards, it is also simplistic to overlook what may be obvious to even a casual observer.